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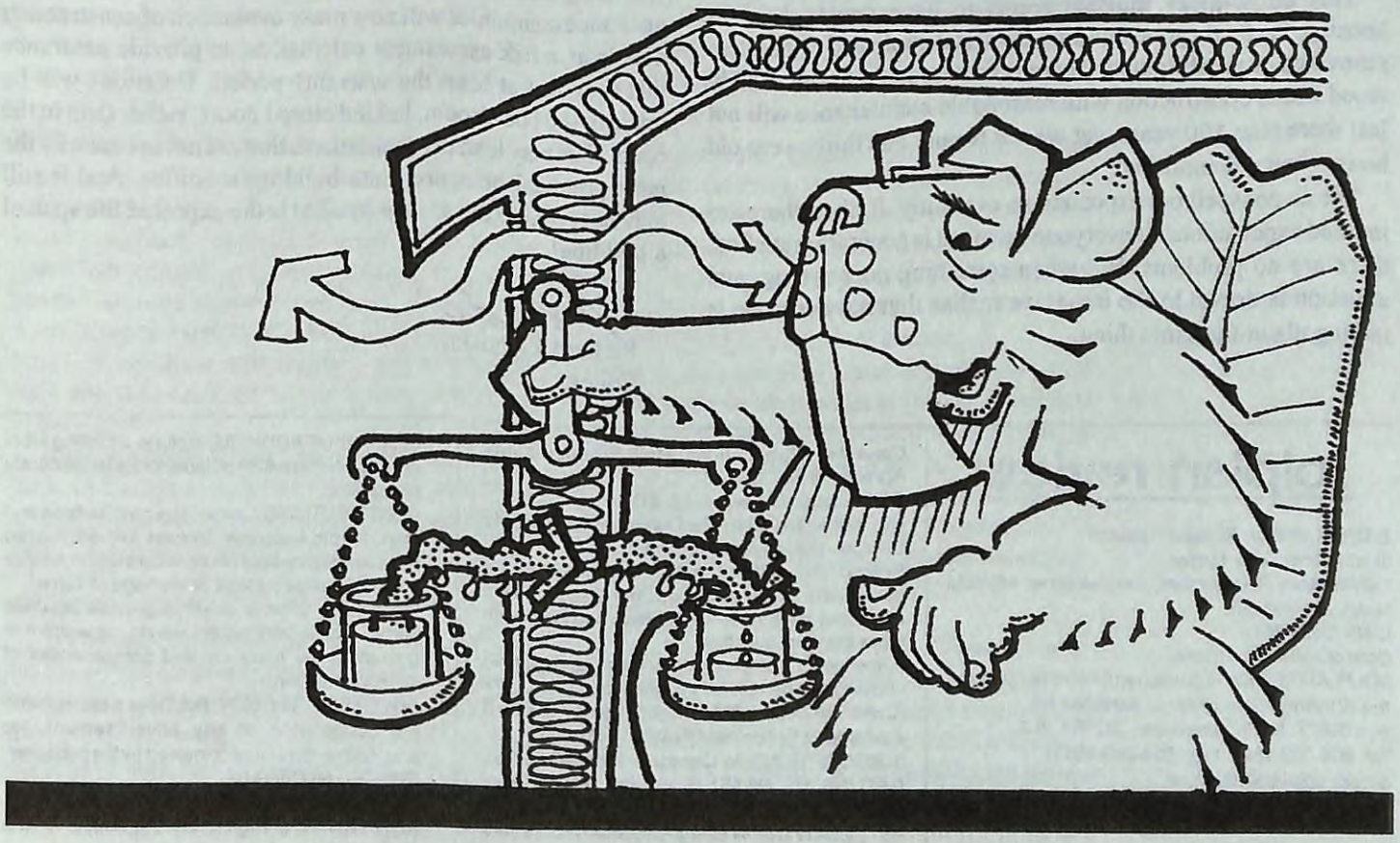
Do We Need Walls That "Breathe"?



From the Editor . . .

What is our expectation for the service life for housing? Is it 5 or 10 years – the duration of typical warranties? Is it 20 or 25 years – the usual mortgage term? Is it 40 or 50 years? Or is it several hundred years – the typical life span in many older established societies such as Europe?

Nothing lasts forever - there is natural wear and tear, but what is an acceptable life for house components? It may seem an academic question like the number of angels dancing on the head of a pin. However, the question is not as academic or arbitrary as it may seem, because expectations define the standard of service, quality control, etc. in our product. To the surprise of many, while codes and standards may explicitly define standards of service, primarily basic structural, health and safety issues, durability is not addressed directly.

In North America we have evolved a terribly wasteful tradition - throw-away consumerism with disposable everything. How many household appliances do we have today that are used for a year or three, and are simple chucked rather than repaired when they break down? Who bothers to upgrade their perfectly functional computer, when buying a new one with new bells and whistles is no more expensive?

This throw-away mindset seems to have caught hold in housing. Perfectly good building stock is demolished rather than renovated or rehabilitated. There is no reason that even shoddy wood frame construction with reasonable maintenance will not last more than 100 years, yet we see twenty and thirty-year old houses being demolished.

We do not spell out expectations explicitly. Rather, there are implied expectations. If everyone involved is generally satisfied, there are no problems. But when something goes wrong, and attention is drawn to the issue, we realise that not everyone is talking about the same thing.

The recent building envelope failures in BC have pointed this out once again. Consumers took it for granted that a building they were purchasing could keep the water out, and that protection would last a reasonable period - maybe even the mortgage period. If there was a warranty, purchasers expected to be covered for any problems. Many purchasers have found out too late that there are limitations to much of the existing coverage, and water leakage is not necessarily covered. Some were told it was buyer beware. Purchasers should have read the fine print and researched what it was that they were buying. But is it fair to imply that water protection is an "option" in new housing - and one that they have to ask for otherwise they may not get?

Some problems have been attributed to normal wear and tear. But what does that mean? How long is the water resistance of an exterior wall supposed to last? What is the acceptable life span of caulking, flashings, roofing membranes and other coating materials? And what about local climatic effects - is that going to have any impact on the life span of materials and assemblies?

These may be academic questions, but they must be answered. Starting this year all new construction in BC must be covered by third party warranty coverage offered by companies operating under insurance regulations. This will mean that insurance companies will now make evaluation of construction details as a risk assessment calculation, to provide assurance that they last at least the warranty period. Decisions will be made in the boardroom, behind closed doors, rather than in the open. This may lead to requirements that are not necessarily the most practical or appropriate building solutions. And it still may not provide the answer to what is the expected life span of a building!

Richard Kadulski,
Editor

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Do We Need Walls That "Breathe"?

By Richard Kadulski

There is much misunderstanding about the purpose of various components in the building envelope. We use terms such as air barriers and vapour barriers to define functions for some components. The building envelope must keep the weather out, keep the heat in (or out, in hot summer weather), and take structural loads that may be imposed (wind pressures and other physical forces). To do their job, materials must be put together properly to form a complete whole.

What we forget at times is that we create buildings to make spaces habitable for human occupancy by separating its occupants from harsh natural environments.

The recent building envelope failures in coastal BC have brought out many traditional myths about today's construction practices and the need for walls to "breathe." These failures have also focused attention on how we look at building practices. The problems have been blamed on the increased levels of insulation being used today and the greater attention given to air sealing. The thinking goes that if we just built the way we used to, all will be well.

However, there are many reasons why we do not build today like we did in the past. We use materials that did not exist 30 or 40 years ago. We insulate buildings for increased comfort; we build more air tight buildings to reduce uncontrolled drafts; and we use more efficient mechanical equipment to condition our buildings. All these factors have contributed to changing building dynamics. Going back to the way buildings were constructed two or three generations ago is just not acceptable. We simply have to learn how to build properly.

Physical Principles

First let's look at how the basic laws of physics apply. Regardless of the climate conditions, the heating systems, or construction materials used, the basic laws of physics are always the same: heat goes from hot to cold; water vapour flows from areas of high vapour pressure to low vapour pressure; gravity pulls water down; porous materials absorb moisture. However, the appropriate details differ from location to location because the conditions each faces will be different in each climate zone.

Moisture in Building Envelopes

Moisture is by far the biggest cause of problems in buildings. When it is warm and wet, biological activity can lead to damage. When it is cold, frozen water can trigger structural damage as ice expands. An area that receives high rainfall, has warm temperatures year round and receives few hours of sunshine will require different details than one that has cold, sunny winters with little precipitation.

Most materials have a capacity to absorb moisture - in fact even when "dry" most materials have a certain amount of moisture stored in pores and fibres. Each material has its own critical conditions for moisture content. Some materials can store more moisture than others. The absolute moisture content will vary based on temperature, relative humidity, the material's capacity to store , moisture and degree of exposure to direct wetting. It is important to remember that moisture absorption and drying is a two-way process.

Two main sources of water are bulk moisture and water vapour. Bulk water is visible. Whether it is poor detailing and construction practices or material deterioration that leads to water leaks, bulk water is relatively easy to deal with simply because it is visible and obvious. Water vapour is less noticeable and its flow is often misunderstood.

Water Vapour

Water vapour has a vapour pressure that depends on temperature, moisture content and atmospheric pressure. Differences in vapour pressure create a driving force to move moisture from an area of high vapour pressure to an area of low vapour pressure.

We are not sensitive to water vapour except in extreme conditions, whether it be on a cold Canadian winter day when the indoor air is drier than in the Sahara desert, or on a hot humid summer day when humidity levels exceed the comfort range.

Indoor vapour pressures in a building are higher than outdoor pressures most of the time, so there is a force driving water vapour toward the outdoors

which is at a lower pressure. However, the direction of the vapour pressure is not always uniform. During some periods of the year, and in some climate zones the pressures can be from the outside in. The important point is that water vapour flows are dynamic. Thus, there no one single way to deal with water vapour.

Vapour Diffusion

The building code uses the term *vapour barrier*, which implies a perfect elimination of vapour diffusion. In reality, with a few exceptions like sheet metals and glass, all materials allow a certain amount of water vapour to diffuse through them. Vapour diffusion, which vapour barriers (or vapour diffusion retarders) are intended to resist, is a weak force that can easily be controlled, even by the limited vapour resistance of many types of paints. A better, more accurate term to use is vapour diffusion retarder.

The forces of vapour diffusion are often misunderstood, and have received much scrutiny lately, especially in the analysis of the building envelope failures on the West Coast. When some suggest we need to allow our walls to "breathe" like in the old days, they are often confusing air leakage with vapour diffusion. In part this confusion may have been created when polyethylene was introduced as an "air-vapour barrier" and little else was considered acceptable to meet the functional requirements.

Much of our understanding of building science has come from the pioneering work done by the National Research Council's work in Saskatoon, and therefore has a bias toward a cold dry continental climate. This is where the "poly air vapour barrier" was strongly promoted because it was an appropriate way to address the issues in that climate zone. However, Canada has other climatic zones as well. We are only now becoming aware of the importance of looking at these other conditions, and realizing that they have an impact on the best details and building approaches to use in those climate zones.

In a cold, dry climate like that of the Prairies, at winter design conditions there is a big temperature difference between indoors and outdoors. However, with an indoor relative humidity of 20 to 30% the vapour pressure differential is modest. On the mild West Coast, monitored results have shown that winter indoor RH is typically above 55%. Although there is a relatively small temperature difference between inside and outside, the vapour pressure difference is significant.

On the West Coast (and in other mild, wet climate zones) materials often become saturated and little drying takes place. Because temperatures are warm, conditions are ideal for biological deterioration. In a cold dry climate like the Prairies, even if some moisture condenses and freezes, it tends to dry quickly - a kind of natural freeze drying.

Air Barriers

Air barriers resist the flow of air through the building envelope. They do not have to meet the vapour diffusion requirements of vapour diffusion retarders, and can be located at any point in the envelope. To be effective, air barriers must be applied properly, and joints sealed. Building materials such as drywall, concrete, or spun olefin sheets (such as 'Tyvek') may be poor vapour diffusion retarders, but, installed correctly, they can be used as air barriers.

Vapour Diffusion Retarders

A vapour diffusion retarder controls moisture transfer by slowing the rate of water vapour transmission through the pores of a material. It is intended to avoid the accumulation of moisture as a result of condensation on colder surfaces. Any low-permeance material can serve as a vapour diffusion retarder, including polyethylene, foils, vapour retardant paints, foil faced rigid foam insulation boards, some closed cell insulation boards, plywood, and vinyl wall papers. It is important to remember that different materials allow vapour diffusion at different rates, so some materials are better diffusion retarders than others.

Vapour diffusion retarders must always be on the warmer side of the wall, otherwise condensation can occur on the colder surface. However, vapour flow can go in both directions in some climate conditions. Solar heating of a wet wall surface can drive water vapour into the building assembly because the interior of the wall may be cooler and at a lower vapour pressure. Therefore, careful analysis is required to decide the optimum location of a vapour diffusion retarder. It will be different in different climatic zones.

Polyethylene is a very effective vapour diffusion retarder. However, there are times when allowing small quantities of water vapour to diffuse through an assembly may be acceptable. The moisture content of building materials and absolute quantities of vapour diffusion will determine whether there is going to be a problem or not. If the moisture content remains below saturation conditions, or if quick drying can take place, there will be no problems related to moisture.

Vapour diffusion retarders do not deal with bulk water movement, resulting from water leakage.

Typical Air Barrier Materials

Materials with negligible air leakage	*Water vapour permeance (ng/Pa.s.m²)*
torch-on roof membrane	
½" gypsum board	1373
¼" plywood	23 - 74
½" OSB	44
1" extruded styrofoam	23 - 92
1" foil faced urethane	negligible
aluminum foil	negligible
6 mil polyethylene	1.6 - 5.8
spun bonded polyolefin	3646
breather type membrane	170 - 1400
	A vapour diffusion retarder must have an initial permeance no greater than 45 (ng/Pa.s.m²)

Direction of Vapour Diffusion

Vapour can diffuse inward or outward. Inward diffusion problems may arise in construction assemblies that can store moisture or that use vapour permeable materials in wall construction. This means that, under certain weather conditions, south side exposed walls could have moisture problems. The moisture source will be water from driving rain, rain penetration or, in the case of new buildings, built-in construction moisture.

For example, a stucco or brick veneer wall has a very large moisture storage capacity. After a heavy rain, the moisture can move into the wall or outward. When the sun heats the wall, the driving force may move the moisture inward, rather than drying to the outside, because the vapour pressure difference favours vapour diffusion inward toward a cooler interior. If the design does not allow adequate venting and moisture drainage, the water can start to accumulate inside the wall.

Summertime inward vapour pressure forces can be two to four times larger than outward winter forces, but are of short duration. However, condensation is more critical in warm weather because conditions are ideal for corrosion and fungal growth. The increased use of air conditioning in homes increases the problem because the interior surface temperatures are lower. This means that the design of building envelopes must balance winter drying to the exterior with summer wetting and drying to the interior.

Suggestions have been made that walls be built without any poly, to allow vapour to flow through the assembly and dry the wall. This is a strategy that may be acceptable for certain conditions in the mild West Coast climate. In a cold climate, the vapour diffusion retarder is still critical.

Although elimination of the vapour diffusion retarder may be acceptable under some conditions, it will not deal with moisture problems that are the result of rain penetration from the exterior. It is also important to remember that vapour resistant interior finishes, such as paint, vinyl wallpaper and many wood panel products also restrict vapour movement and contribute to vapour resistance.

Air leakage

Airtight construction practices became a significant feature of house construction in the mid 1970s as an energy conservation issue. At the time, it was realized that air leakage was one of the largest factors in house heat loss. This is especially the case in cold climates where the temperature difference between inside and outside can exceed 50°C (more than 100°F).

Loose, leaky construction does not only mean cold drafts into the house. Air leakage is also the driving mechanism for the movement of moist, warm indoor air to cold areas where damage to the structure can occur when the moisture condenses on cold surfaces. Air movement in and out of a building will take place through holes or gaps in

"Breathing" Walls

There is no such thing as a "breathing" wall. When people refer to walls that "breathe" it is typically to a construction assembly that has a less than perfect vapour diffusion retarder that allows water vapour to move through the construction assembly. It must still have an effective air barrier. This may seem like a very subtle difference, but it is perhaps a key to avoiding moisture problems.

Proper building envelope design should still provide control from the elements, keeping the outer layers of the cladding dry, reduce inward moisture movement (e.g., by using heavy building paper, extruded polystyrene insulation, etc.), and control of vapour diffusion. Interior moisture levels have a big impact on the performance of materials in the wall.

the construction, for example, around window and door frames, electrical outlets, between wall/floor plates, plumbing or service stacks. In a wall, wet materials provide ideal conditions for fungus and rot to attack structural wood.

Air movement is responsible for moving most of the moisture through the building envelope. The driving force can be a pressure difference between the inside and outside created by wind acting on the building envelope, and by the stack effect created by a temperature difference. Thus the need for an air barrier is not just an energy conservation issue, but an important consideration for the durability of the structure. ☼

Heating Cost Guarantee

Enbridge Consumers Gas launched its "Ultimate Comfort Guarantee" at the Ontario Builder Forum in January. It provides homeowners a three-year comfort and heating cost guarantee.

This is a pilot program being done as a utility demand management project, so it is not subject to vagaries of a deregulated marketplace. Program costs will be monitored against energy savings.

Each house participating in the program must have a heat loss simulation performed, forced warm air heating systems must have all ductwork sealed, and the house has to meet minimum air tightness criteria (2.5 ACH). In addition, two inspections will be done: one before drywall, and one before occupancy, when the blower door test will be done and heating distribution balance verified. The program guarantees that the temperature in all rooms will be ± 1.5°C from the mean temperature.

The program criteria are meant to be achievable by mainstream builders. The intent is to ensure that homes are built with properly sized and laid out heating systems. Gas fired hydronic heating systems are also covered in the guarantee.

This guarantee program does not set out an energy consumption target (as in the R-2000 program) so that standard code construction is acceptable. However, if a builder wishes to build to R-2000 standards, that is also acceptable. The bottom line in the guarantee is determined by the heat loss calculation, so builders could use the guarantee to push the energy efficiency envelope as far as they wish to go.

Is it possible we will see builders promoting how little it costs to heat their house with a written guarantee to prove it? ☼

For information:
Enbridge Consumers Gas New Construction Hot Line: 416-495-5371

Health Canada Issues Advisory on Ozone Generators

Health Canada is advising the public not to use ozone generators in their homes. The concern is with the adverse health effects that may result from exposure to ozone from air cleaners that generate ozone gas. Ozone is an irritant that can cause coughs, chest discomfort, and irritation of the nose and throat. The direct and purposeful generation of ozone indoors should be avoided.

Following a review of current information, the Canadian Standards Association (CSA) recently decided not to certify ozone generators for household use and issued new interim requirements for commercial units.

Health Canada advises all owners of ozone generators to stop using them in their homes. Owners of commercial ozone generators are advised to either stop use or have their devices tested to ensure that recommended exposure levels for ozone are not exceeded. Commercial ozone generators should never be used in homes.

Products affected include portable, breadbox sized units that plug into the wall, and some smaller units that may be battery-powered. Most devices of this kind have been sold door-to-door, and not in retail outlets. ☼

Health Canada is working on a voluntary recall of ozone generators sold for household use. For more information: call 1-800-267-3364 (Monday to Friday 9:00 a.m. to 5:00 p.m. EST).

Building Codes: No Guarantee Against Earthquake Damage

It's a myth that all wood-frame houses are earthquake resistant. Construction methods, materials, and details typically used defeat the inherent resistance of wood-frame construction. Earthquake damage usually results because of the absence of attention to elementary construction details.

More than one quarter of Canada's population lives in areas that are historically and geologically prone to earthquakes severe enough to cause widespread damage and loss of life.

However, people living in areas of high seismic risk seem to live in a state of denial. They seldom appreciate the risks they face. They are not aware of the elements that determine earthquake risks and do not know the simple, relatively inexpensive corrective steps that could make their lives and property safer.

The actual force of an earthquake may be much greater than the levels currently recognized in Canada's building codes. The seismic provisions in Canadian codes do not ensure that a building will be either useable or repairable after a "design earthquake" or that its contents will not be significantly damaged. The code philosophy for seismic design is that a building should be able to resist moderate quakes without significant structural damage and major earthquakes without collapse. The objective is to reduce fatalities, to accept some structural damage, and prevent collapse. However, the code assumptions for houses use earthquake forces that are only 40% of those that occurred in the 1995 Kobe, Japan and the 1989 Loma Prieta, California earthquakes.

Houses are traditionally built to resist large vertical loads such as snow, the weight of people and furnishings, and smaller horizontal loads such as wind. Even a moderate increase in attention to details can deliver wood-frame houses that are safer for their occupants and a better investment for their owners. Too often, a lack of thought to structural concerns leads to a structure where the whole is weaker than the sum of its parts. Earthquake resistant design needs an integrated approach. It is possible to create a house in which "the whole is stronger than the sum of it parts".

A myth that must be dispelled is that all wood-frame houses are earthquake resistant. Although most Canadian houses are built of wood, which is inherently resistant to earthquake damage, the construction detailing does not include appropriate connecting elements. Earthquake damage usually results because of the absence of elementary construction details. Standard construction methods, materials, and details used defeat the inherent resistance of the wood-frame. Applied finishes and appendages (such as masonry chimneys) are not adequately secured to the wood-frames.

No matter the sophistication of the seismic design and the thoroughness of the details, it is the quality of the construction that determines the performance of the house under earthquake conditions.

The heavier the building, and the higher the weight is above the ground, the greater the damage potential.

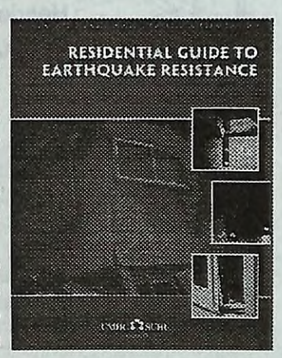
The foundation is the first element in the house to experience the force of the earthquake and is the element that must endure the greatest forces. To resist seismic forces successfully, a house has to be attached to its foundation and it structural components have to be tied together. These details are essential to limit damage during an earthquake. However, they are usually overlooked in new houses and rarely found in older ones.

An elementary example is the continuing practice of construction without any anchor bolts connecting the wood frame to the foundation in areas with a high risk of earthquakes

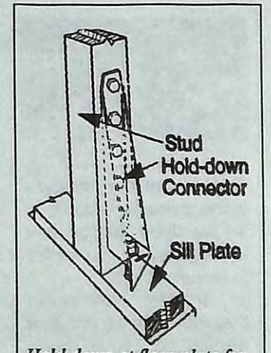
Many potentially damaging characteristics of existing wood-frame houses and their contents can be corrected as a renovation project, or undertaken along with other renovation projects.

CMHC has just published the ***Residential Guide to Earthquake Resistance.*** The guide has been written to increase awareness of earthquake hazards and to help those who are at risk to make good judgements regarding seismic upgrading. Although the point of view taken is for a renovation, the principles apply equally to new construction.

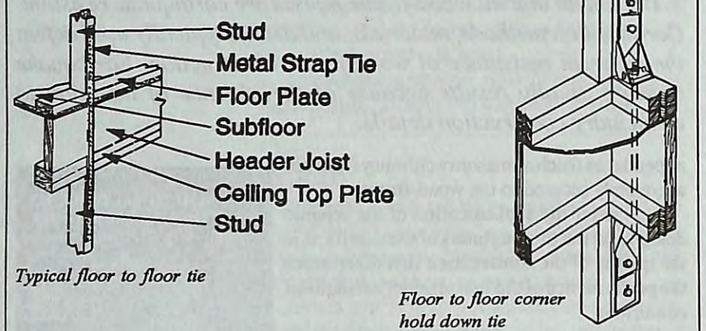
The book helps to establish priorities and provides construction details useful for both existing and new buildings. It uses a simple-to-follow workbook format to help users assess the seriousness of house deficiencies, and to decide whether they involve risk of loss of life, loss of shelter or property damage. Background material is provided throughout. A case study shows how to use the worksheets in the workbook.



Residential Guide to Earthquake Resistance, *CMHC $39.95*
Available from selected bookstores or CMHC: 1-800-668-2642



Hold down at floor plate for retrofit and new construction



Typical floor to floor tie

Floor to floor corner hold down tie

Seismic detailing, especially when retrofiting an older house, requires the careful use of a variety of engineered connectors.

Detailed information about seismic activity in Canada can be obtained from the web site maintained by Natural Resources Canada at *www.pgc.nrcan.gc.ca./seismo/table.htm*

Building codes do not ensure that the structure of a house will be undamaged after an earthquake.

The content of the Guide is shaped by two underlying concerns - risk to occupant and strength of the existing house. The Guide is intended as a reference for builders, renovators, architects, engineers, technologists, municipal officials, and other knowledgeable parties working with existing and new single family homes.

Details that will strengthen the structure and help lessen or prevent damage to a house from earthquakes are included. They are not a set of specific instructions but rather a guide for design professionals, contractors and building officials when evaluating a house.

The content is organized according to to three priorities:

Highest Priority Maintaining personal safety during and after an earthquake;

Second Priority Retaining the house in a habitable, repairable state after an earthquake;

Lowest Priority - Minimizing damage to the building and its contents. ☼

Prevent Water Damage - For Better Health!

Details that will minimize water damage include:
✔ plumbing fittings and connections in accessible locations.
✔ toilets connected through the wall, not floor mounted.

Water leaks in a house cause great inconvenience for its occupants. Water damage may be a result of leaky floor drains and pipe joints in bathrooms, leaky joints between bathroom walls and floor, leaks at pipe joints inside sink units, leaking drains and heating pipes. This can lead to bad indoor air quality, health problems, unpleasant smells, and repairs to floors.

Sometimes we create problems when we build. No one is immune! We often consider that Scandinavians are meticulous designers, so they should not have any problems with their buildings. However, they too have problems.

Ten years ago, when it was noted that plumbing was a source of ongoing water damage problems, a project was devised in the northern Swedish city of Umeå. The design of many residential projects was modified. Each followed several simple rules that required pipes and couplings to be installed so any leaks could be quickly detected and easily repaired, set out how to seal around a floor drains, how to draw up good operating instructions, how to adapt the layout to achieve the greatest possible resistance to water damage, etc. Four thousand units were built with special emphasis on preventing water damage. Low rise and high rise buildings as well as single family houses were included. The extra measures cost money, but it was calculated that costs would be recuperated in less than three years.

Savings on property insurance compensated some incremental costs. Insurance companies noted a difference in claims and gave a 30% rebate on house insurance premiums for buildings that satisfied the requirements. This was good business not only for the residents, but also for the insurance companies because there was no damage, and therefore no payouts for compensation.

In the ten years that have passed since the project was started, there has been not one instance of water damage in the units although, statistically, around thirty instances should have occurred.

Buildings constructed according to these guidelines can also be altered and renovated more easily than conventional buildings, and at a much lower cost. ☼

Technical Research Committee News

Ventilation Requirements

The 1995 NBC ventilation requirements introduced significant changes in the building code. This has led to problems and considerable frustration between builders and building officials across the country. In some jurisdictions building officials have yet to develop formal procedures to enforce compliance. Unfortunately, builders are responsible for the systems built into the house, so to avoid problems they must meet minimum applicable standards whether or not others inspect these.

The main reason for ventilation requirements in the first instance is to provide good indoor air quality. Our current understanding of building science issues is sufficiently advanced that we recognize that air change and flows in today's houses is complex and requires special attention.

The significant changes in the 1995 NBC from the previous code include:

- ventilation capacity must be based on a room count
- outdoor air must be distributed through the house, either by the heating system or separate ducts
- the principal fan must be able to run at 50% of total required capacity (i.e., it must be possible to control the rate of air flow so it is not on at maximum all the time)
- make-up air must be provided for exhaust fans greater than 75 L/s
- fans must be rated and meet minimum sound ratings.

The main concern is how to comply with the code in a way that does not add significant costs. Initial results indicate that few new houses built under the 1995 NBC requirements meet all code requirements. Several issues have been identified as problems so far. In small or airtight houses, it is possible for NBC-acceptable levels of unbalanced exhaust to cause significant levels of combustion gas spillage that may exceed gas code tolerance. Other common problems are noisy fans and no direct exhaust from the kitchen.

A study now underway is trying to establish how code compliance is being met by builders, where the problems are, and what can be done to make compliance easier.

Code Compliance Responsibility

Builders in Saskatchewan were made aware that some code provisions have not been inspected by all local code jurisdictions, but this will start this year. Code compliance is ultimately the builder's responsibility. Local authorities may be partially liable, but ultimately it is the builder who is first in line.

CHBA and local associations will maintain a dialogue with authorities to balance consumer protection against builders' risk.

Guard Rail Details

Ontario regulations have introduced tighter design requirements for handrails, which include strict design loads and fastening criteria. These are being applied to interior as well as exterior railings. In part, these requirements have been driven by legal considerations. The implications are that more substantial designs are required than in the past, including the engineering design of all railings, which can lead to additional costs and over designed connection details.

Acceptable standard details and other possible solutions to the problem are currently being worked on by CHBA, the Canadian Wood Council, the Canadian Codes Centre, and the Ontario Ministry on Housing.

Floor Vibration Criteria

Wood products are strong but flexible, but they bend under loading. That is why we see old houses held up with what today is considered unacceptable structural framing. Their floors may be structurally adequate, but are very "soft" , reminding one of a trampoline. Engineered wood joists can carry even larger loads than dimension lumber, but they are equally vulnerable to the soft floor. In fact, soon after the introduction of wood joist floor systems some years ago, there were problems as floors were built strictly according to design loading criteria, structurally sound but so soft they led to customer complaints.

New designs for engineered floor systems include vibration criteria. Manufacturers are starting to comply with the CCMC's vibration criteria for engineered wood systems for floor assemblies. New span tables and computer design software have been developed. Builders should check with their suppliers whether the span information they are working with meet the vibration standard.

Canadian Home Builders' Association

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector.

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New Focus On Polybutylene (Poly-B) Plumbing

Should the thousands of home owners and builders who have used poly B water systems be lying awake at night waiting for the sound of bursting pipes? The Canadian Association of Home Inspectors (AB), the Mechanical Contractors Association of Alberta, the Calgary Home Builders' Association and the New Home Warranty Program have received many inquiries because of recent alarmist media coverage. The consensus among home inspectors, plumbing contractors and home builders is that there have only been a few isolated cases where poly B plumbing has caused any problems. Overall it is a system with a good track record for use in potable water home plumbing systems.

With hundreds of thousands of installations and only a handful of complaints, why has poly-B suddenly become an issue? A North Vancouver law firm is searching for subscribers to a proposed class action suit against some companies that manufacture poly-B pipe and fittings. However, unlike the U.S., there have not been many cases of poly-B pipe failure in Alberta or other parts of Canada.

In the U.S., around one billion dollars was set aside in 1996 by Shell, Dupont, and Hoescht Celanese as a class action settlement to compensate homeowners for poly-B piping that failed. The group dealing with claims is known as the Consumer Plumbing Recovery Center and can be reached at 1-800-356-3496 or 1-800-876-4698. The Center will help Canadians who have a legitimate claim, although the claim process is different. However, the Center has had very few Canadian requests because the problem has occurred mainly in the United States.

Shell stopped supplying the Polybutylene beads to US manufacturers in 1996. It seems that most of the US poly-B failures are a result of failure of plastic "acetal" in-line fittings, which are rarely found in Canada. Today most plumbing systems are installed with polyethylene cross-link pipe systems (PEX).

In the U.S., high chlorine levels (above 2 ppm) in drinking water are suspected as one cause ofaccelerated deterioration in plastic fittings. Such levels of chlorine are much higher than normally encountered in Canadian drinking water. That is one reason poly-B piping has never been a good choice for swimming pool piping. Anther problem cited is aluminium crimp rings failing at the fittings. But few aluminium crimp rings have ever been used in Canada.

Many of the U.S. failures occurred in mobile homes where the plumbing lines were run in the attic area causing the pipe to bake when subjected to the extreme heat generated by hot southern summers. These problems relate to materials and conditions unique to the United States. Carey LaRose, chief plumbing official at Alberta Labour reports that only two poly-B failures have been reported, and both were the result of poor workmanship.

Some problems have been reported with poly-B piping used in heating systems. The lack of an oxygen barrier in the grey poly-B pipe allows oxygen to enter the water. This can cause premature corrosion of metal parts in the system such as the boiler heat exchanger and circulation pumps. This problem can usually be remedied by installing a non-ferrous pump and heat exchanger.

In rural areas with poor water quality, oxidation can cause excessive rust to develop and block the entire system. In 1993, the Plastic Pipe and Fittings Association listed the following limitations on poly-B piping:

1) Do not use poly-B a continuously circulating hot water plumbing loop.
2) Do not use it where water temperature could exceed 180 °F.
3) Do not use it in an application where the pipe will be exposed to direct sunlight.
4) Do not allow a poly-B pipe to be left exposed to direct sunlight for more than 30 days during or before construction.
5) Do not use acetal insert fittings.
6) Make water heater connections with a metal connector at least 18" long.
7) Keep the poly-B pipe a minimum of 6 inches from the hot water tank or furnace flue pipes.
8) Do not use poly-B in swimming pool piping systems or where more than 2 ppm of chlorine will be routinely encountered.

How Long Does It Take a House to Cool Down?

Stormy winter weather often brings power outages. In most houses today that also means a loss of heat, which translates to occupant discomfort and, in extreme cold weather, damage caused by burst pipes. Because every house stores a small amount of heat in its building materials, it takes some time for the house to cool down.

How long does it take a house to freeze up in cold weather? Obviously, a lot depends on the house's design, the amount of insulation, the house's thermal capacity, and the solar potential. Passive solar houses, designed with larger amounts of thermal mass, will store more heat than a light wood frame house with no concrete or masonry. Cool-down time is often called a house's "time constant".

Absolute values for time constant are hard to establish, as there are many variables. In extreme cold weather, solar gains provide significant heat input. Even the basement may be a source of heat gains, as the ground temperature hovers in the +3 to+8°C range year round, depending on the location. As air temperature drops, the basement actually may be warmer than the above grade portion of the house, thus contributing to moderate the indoor environment.

Interest in the cool-down time resurfaced last year in eastern Ontario and Quebec when the ice storm disrupted power in some areas for several weeks. An internal Hydro Quebec study monitored the performance of several conventional and Nouveau Confort (near R-2000) houses. The study was not definitive, but it does point out interesting trends.

With the heat shut off, when the outdoor temperature averaged -20 °C over a 15-hour period, the Nouveau Confort house went from 18.3 °C to 13.4 °C, while under the same conditions the standard code house went from 17.8 °C to 8.5 °C. The 15-hour period is significant because that is the approximate length of night in southern Canada, when there is no solar potential to provide solar gains to the house.

Calculations showed that without solar gains, and with a uniform outdoor temperature, the standard house could cool to 3°C, while the Nouveau Confort would be at 10°C. In theory, the standard house would cool down to freezing in about 28 hours, while the better insulated Nouveau Confort house would take about 54 hours.

This study points out another justifiable reason to build homes with better insulation standards. ☼

For information on the R-2000 Program, contact your local program office, or call 1-800-387-2000

HOT2000 version 8 A Review

by Richard Kadulski

HOT2000 is the energy analysis software that has become a standard in residential energy performance evaluation. It was originally developed as the compliance tool for the R-2000 New Home Program, but it has been found useful for many other applications, including code and retrofit analysis. Until now, HOT2000 has been strictly a DOS program. In the world of computers that made it a dinosaur, regardless of how well it did the job.

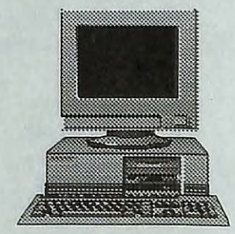
A new Windows 95 version of HOT2000 has just been released. HOT2000 version 8.0 has a new look but, except for a few small changes that can be considered fine tuning, the technical core of the program remains essentially unchanged.

The biggest change is the way foundations are modelled. In older versions, you decided the kind of foundation the house had, and made assumptions about where to split different segments of the foundation. The new version has a larger number of foundation systems, and treats the foundation as a whole, rather than breaking it into segments.

Walkout basements can now be input as a foundation type and do not need to be split into slab, shallow basement, and full basement sections. However, the foundation must be rectangular shaped. If the walkout is not rectangular, you have to do manual calculations to come up with the equivalent rectangular dimensions. A complex formula is provided in the help file to explain how to do this. Decidedly, not an improvement!

Another problem is that the above grade wall in the walkout basement is assumed to be the same construction type as the in-ground basement. In the real world, this wall is usually significantly different.

New calculations allow HOT2000 version 8 to model solar radiation on sloped surfaces in all directions, so windows can be modelled at any tilt angle. Skylights can now be input as a type of window and not as part ceiling and part window. However, window entries must be made in inches (or mm), while all other dimensions use feet (or m). This contributes to confusion!



Steel stud calculations have been modified to reflect test results at the National Research Council.

An error was found in the old formula that calculated air infiltration. This means the natural air change rate was overestimated by, on average, 0.09 ACH and the energy consumption by 5% to 10%. This has now been corrected.

The R-2000 energy consumption target calculation has been modified to reflect the new foundation calculations and the changes to the solar utilization model. The target has been adjusted so that in most cases there should be no effect in the target.

User Defined Codes

User defined codes are now stored in a separate library that can be accessed from any house file. However, any user defined codes used in a given house file are also stored within the house file, so if you move the house file to a different computer that does not have the Code library, HOT2000 can still do a calculation on the house.

Global Changes

In previous versions of HOT2000, if you wanted to change all windows (say from double glazed to double glazed with a low-e coating) you had to make the change to each window individually. A global change feature has now been added which allows you to select multiple windows and specify the change to them all at once. This global change feature has been extended to all envelope components and to some of their dimensions.

HOT2000 uses effective R values, calculated by the program from the construction details the user enters through pop-up lists. These take into account thermal bridging and compression of insulation in the attic along the eaves. The materials selection pop-down lists can now be customized. This is handy for those who only use a few construction types or materials.

Impressions

What is my overall impression of HOT2000 version 8? Is this the ultimate version of HOT2000 you can't do without? Being an armchair quarter back and commenting from the sidelines is easy. As the program core has been validated extensively, we know it is a good, accurate program. Any change that makes it easier to use is to be lauded.

Version 8 has many typical Windows features. These make the software easier to use. However, users familiar with older versions of HOT2000 will find the transition frustrating. The process of translation to another platform means that bugs do exist and will be corrected. The new changes to the program and how to prepare entry data are not well documented, and there is no tutorial to guide new (or old) users.

To my mind the biggest weakness is the documentation. Following with the trend in the software industry, the documentation is online without a separate hard copy manual. Online documentation is handy if you know the terms to use and precisely what you are looking for. Otherwise, it is a tough slog through an on-screen manual. The lack of a tutorial - be it written or on line is a missing feature I would like to see.

We know that, with all their resources, Microsoft is not able to launch new program versions without bugs. The resources available to the NRCan group behind HOT2000 are meager in comparison. Yes, there bugs and problems in this version. However, the most obvious glitches are being dealt with now, and its makers are good at informing registered users of updates. ☼

HOT-2000 version 8 is available from the Canadian Home Builders' Association. $295.00 plus GST (HST where applicable, US dollars for US and International orders).
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Thermal Storage for Electric Heating

Electricity is used for space heating in many areas. For some utilities, it creates load problems as the heater use may often coincide with peak electricity use. Some have rate structures that change according to time of day, to encourage power use at other than peak periods. In those areas, using electricity consuming appliances to charge up thermal storage when power rates are lowest is advantageous.

The traditional electric heaters (most commonly baseboards) do not provide any thermal storage. A European thermal storage electric heater is now available in Canada. Essentially, it is a heater with high heat capacity bricks that absorb heat during the low rate period, and release it during high cost times. The peak storage capacity is 8 kWh (27,304 BTU) for each kWh used to charge the unit.

The company plans to manufacture in Canada when sales warrant.

It worth it? If electricity is the only heating option, and time of day electric rates are in place, then this type of system merits consideration. ☼

Information:
Olsberg Canada Inc.
Tel.: 705-721-1388
Fax: 705-721-0299

Eliminating moisture helps allergy sufferers

Moisture problems occur far too often in dwellings. Moisture not only causes damage to finishes and the structure, but it also affects human health. Many studies have shown a relationship between symptoms of ill health and living in damp dwellings. A damp environment also increases the risk of toxic microbial substances and the growth of allergens, such as those given off by house dust mites.

Moisture in houses has many sources, and not always visible. A recent research project in Sweden looked at dwellings that had moisture damage, both before and after remedial action. In the study all homes had musty odours, but in some the odour was highly localized, for example, confined to a single room or area of a room. In half the houses, there was no visible mould or damp patches, even though moisture damaged areas were found on close inspection.

The houses surveyed were home to adults who were allergic to house dust mites. An allergy specialist tracked the state of health of these patients. After remedial action had been taken, the families and patients were asked if they had noticed any change in the building. Without exception, both patients and family members considered that remedial action had resulted in positive changes and resulted in a marked reduction in their general allergic symptoms. There was an improvement in health, comfort and - in particular - air quality.

A study now being completed in Ottawa has resulted in similar findings. ☼

Solplan Review Back Issues

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Bundle special: a random selection of back issues (minimum 22 copies) are available for only $55.00 (plus 7% GST).

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New Danish Centre Studies Pollution in Indoor Environments

There are still many gaps in our knowledge about indoor air quality. What is it in some buildings that makes us sick? Is it chemical or biological airborne pollutants? Which airborne pollutants are damaging to health? How are we affected by exposure to both airborne pollutants and different combinations of temperature and humidity? What ventilation rate is best for health?

A new international engineering science centre has been created at the Technical University of Denmark in Copenhagen. The centre will research how to build healthy, comfortable and durable energy-efficient buildings, and is one of a series of research initiatives on indoor air quality in various countries.

The centre will test new ideas about the relationships between indoor environment and health. Because each individual has his or her own response, there are few absolutes. Research has to look at the effect of a given factor on many people and attempt to learn the optimum tolerable range. A focal point of work at the centre will be human exposure in climate controlled rooms. Subjects can be exposed to different building materials in combination with different thermal loads (e.g., temperature and humidity), and also to noise and lightning. ☼

No, these people are not sniffing glue. They are putting to use one of the most sensitive instruments we have for indoor air quality investigations: our nose.

The Rebirth of Lineoleum Flooring

Linoleum was the original resilient flooring material. When vinyl appeared, linoleum lost most of its market share. However, it was always available in large sheets, and was used in some commercial and institutional applications.

Recent awareness of the need to maintain good indoor air quality, and to use natural materials has led to resurgence of interest in natural products such as linoleum. Manufacturers are responding with new products. Forbo, one of the major flooring manufacturers has introduced Marmofloor available in composite pre-glued panels. Each 1200x240 mm panel (47 ¼" x 9 ½") has a linoleum wear layer over a wood fibre laminate whichallows easy application. Different coloured panels can be used to form creative flooring patterns.

Information:
Forbo Resilients Inc.
Tel: 514-990-9700
Fax: 514-967-0018

NRC·CNRC

Predicting Mold Growth in Walls

by Mostafa Nofal, Ph.D.

Moisture levels in the building envelope can cause biological, chemical, physical, or structural damage to construction materials in houses. The type of damage depends on the temperature, moisture levels, time of exposure and mechanical loading and also the types of building materials. In wood-frame construction, wood products may be damaged by biological activity.

The Institute for Research in Construction (IRC) at the National Research Council of Canada (NRC) is developing a method to assess durability by linking structural and hygrothermal analysis computer models.

Determination of the Rate of Damage

The development of a good moisture damage model requires experimental data. Damage due to biological action is one mechanism that affects wood durability. A wide range of organisms, including fungi, termites, carpenter ants, wood-boring beetles and marine borers, can live in and consume wood depending on the materials, the location and the micro-environment.

Fungi damaging building envelopes are mainly mold, mildew, and wood-rotting fungi. Mold fungi also cause odours and health problems in some individuals. Under the right conditions fungi cause significant loss of strength in wood materials. A fungal attack depends on six critical requirements:

1) wood type,
2) free or unbound water,
3) favourable temperature,
4) a characteristic time of exposure,
5) oxygen and
6) available, digestible carbon compounds.

The results of experiments conducted in Finland were used to develop a formula for the rate of mold growth. The experiments identified how much time it took for initial growth and percentage of area covered with molds.

To predict the mold growth, it is necessary to know the type of building materials and relative humidity and temperatures of the surface over the simulated period. The temperature and relative humidity are obtained either from field measurements or from predictions.

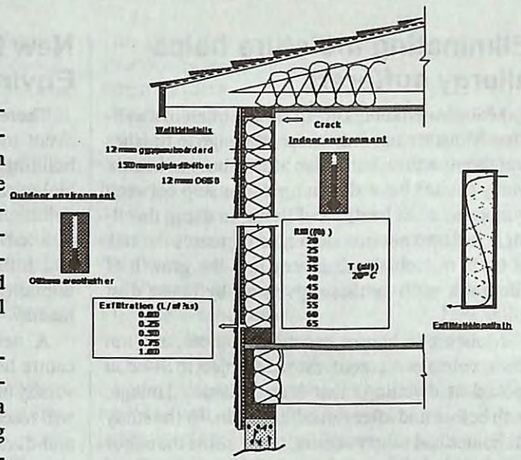

Fig. 1 Wall system and boundary conditions for worst case scenario for exfiltration.

Mold Growth Prediction

For the case of exfiltration shown in Fig 1, the bottom and top of the sheathing membrane is most susceptible to mold growth. Mold growth increases as the air leakage rate increases (Fig. 2) and decreases as the relative humidity of the surface decreases.

An indoor relative humidity of 20% to 35% gives the same amount of mold growth. Only the bottom 40 mm of the wall was covered by mold for indoor relative humidities higher or equal to 35%. These results show that hygrothermal analysis alone cannot be used to assess performance and durability. The results show that exfiltration rates are much more important for mold growth than once thought.

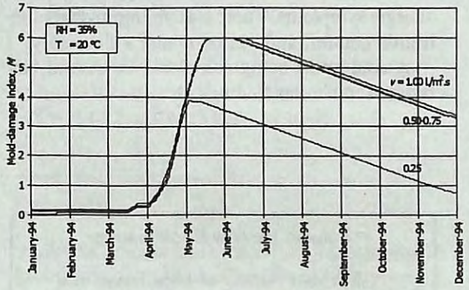

Fig. 2 Effect of air leakage rates on mold growth

Dr. Nofal is a researcher in the Building Envelope and Structure Program of NRC's Institute for Research in Construction.

Mold growth begins with air leakage more than 0.1 L/m²s. Fig. 3 shows the change in mold growth depending on the air leakage rate at different indoor relative humidities.

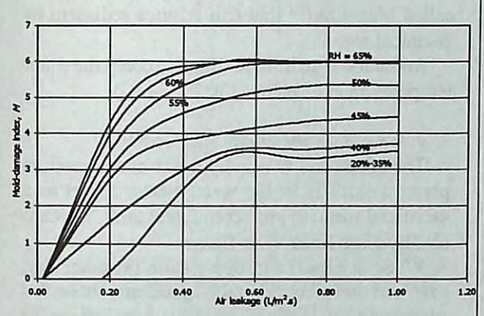

Figure 3: Variation of mold growth

Mold growth increases significantly in the range of 40% to 55% RH (Fig. 4). However, air leakage with indoor relative humidities between 20% to 35% will cause invisible mold growth.

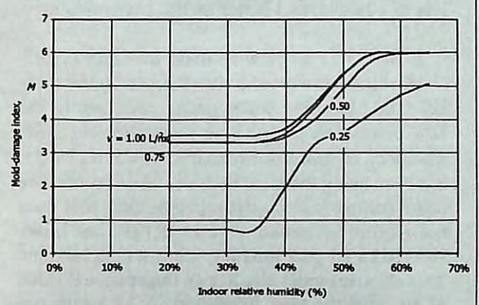

Fig. 4 Effect of Relative Humidity on mold growth

Conclusions

Mold growth will be most pronounced at the bottom and the top of the wall. Mold growth depends on the indoor relative humidity and temperature. High indoor relative humidities increase the probability of mold growth.

The initial results show that durability is not just a function of the strength of the different materials. Physical, biological, and chemical processes are also responsible for the durability of building envelopes. Analysis shows that the air leakage has a significant impact on the wall performance. ☼

Letter to the Editor

Re: Quiet Fans (Solplan Review No. 84)

In your January 1999 issue you had a table listing solutions for noisy fans. We found it peculiar that we did not see our products listed in that table. Our products meet the stringent criteria for quiet fans stipulated by the BC Building Code. The units are also rated and listed in the HVI handbook.

Kanalflakt is an international ventilation products manufacturer with our North American manufacturing facility in New-Brunswick.

Marc Leger P. Eng.
Customer Service Manager
Kanalflakt Inc. Bouctouche, NB

Kanalflakt fans that meet the BC Building Code criteria are:

UQ 80	*80 cfm*	*0.8 sones*
UQ100	*100 cfm*	*1.2 sones*
UQ140	*120 cfm*	*1.5 sones*

Candle Power

You've heard about the energy efficient houses that can be heated just by a candle. But how much heat is there in a candle?

The BTU content of wood is about 8,000 BTU/lb, while a candle is about 15,000 BTU/lb. (You should allow about 10% chemical energy loss from CO and soot). Thus a 4 oz candle that lasts 4 hrs will give you roughly 850 BTU/hr or 250 watts.

Thanks to Norbert Senf of Masonry Stove Builders for this gem.

energy efficient, sustainable, and healthy buildings
design & consulting services
R-2000 File Management
HOT-2000 Analysis

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Energy Answers

Frequently-Asked Questions on Water Heaters

Rob Dumont

The water heater is the second largest consumer of energy in most homes.

1. Are there any good books available on water heater troubleshooting?

I recommend **The Water Heater Workbook** by Larry and Suzanne Weingarten. I ordered my copy from Amazon Books after finding the book on the Internet.

The 154-page book mixes armchair philosophy, relevant theory and a heavy dose of practical knowledge. It has answers to questions such as "Why does my water heater produce a rotten egg odour?" (Answer: You have the wrong type of anode rod for your water. Use a zinc anode rod instead of magnesium.); "Why am I getting cold water if the burner is on?" (Answer: The vertical dip tube in the water heater is broken, and cold water is mixing at the top with warm water.); and "Why do water heater tanks leak so much?" (Answer: The anode rod inside most water heaters dissolves over time, and electrolytic action causes the tanks to leak.)

The authors present an interesting statistic: "Every year for the last ten years an average of 5,700,000 water heaters (about 80% of the water heaters shipped in the United States) were sold as replacements . . . What a pleasure it has been to learn there are relatively simple things which can be done to maintain water heaters, to **more than double** (emphasis added) their useful life, and to vastly reduce the number of replacements needed."

2. What can be done to "more than double" the useful life of water heaters?

The two most important things to do are periodically to clean the inside of the water heater to remove deposits of sediment and lime, and to replace the anode rod before it has reached the end of its useful life. The authors recommend replacing anode rods in water heaters that are more than six years old (if you are using softened water, the anode rod should be replaced about every two years.)

3. How do you clean the inside of a water heater?

Commercial water heaters generally have a side port that can be opened for access, but with residential models, there are no side access ports. Periodically opening the water drain valve at the base of the tank can help remove some sediment. The professionals have access to a tool called a Muck-Vac™, which does what its name says. There is also a citric acid descaler on the market called Mag-Erad™ that can remove sediment by chemical means.

Another way to limit scaling is to keep the water temperature at or below 130°F (54 °C).

4. What does the anode rod look like?

The anode rod is usually a rod of magnesium placed vertically in the water heater to act as a sacrificial metal to protect the steel tank, which is usually glass lined. (See figure)

While at a building supply store the other day, I noticed that a residential magnesium anode rod costs about $20. A plumber could likely replace the anode rod for about $100. The cost of a new basic gas-fired water heater is about $250 plus tax, and the total cost to have your old one replaced and a new one installed is about $475 in our area.

Replacing an anode rod is definitely cheaper than replacing a water heater, and of course much less of a hassle, and better on the environment.

5. Are there alternative tanks that don't rust?

Now there are several alternatives on the market. The Marathon water heater company in the U.S. produces a plastic tank that is non-metallic. Manitoba Hydro, a utility that rents water heaters, has been using them for their rental program. The Sears company also sells a plastic tank that does not require an anode. One model (Power Miser 10+) has a 10-year warranty against tank leakage. This electric model also has an impressive R value of 16.7 for the tank insulation. A 37.5 imperial gallon (170 litre) tank is priced at $400 Canadian.

The Sears model also has a cold water inlet tube that swirls the water in the tank to help prevent a sediment build-up.

OSO Hotwater North America in New Brunswick markets a stainless steel electric water heater.

6. Have you heard of any safety problems with water heaters?

In the **Water Heater Workbook**, the authors tell the following chilling story:

"Most water heater owners don't know they need to check their Temperature and Pressure (T& P) Relief Valve every six months or so to be sure it's still working, and these folks were no exception. One very cold night, when they were out of town, the water in their pipes froze. When the water heater came on, there was no place for the expanding water to go because the cold water line was blocked with ice, and the T&P valve was stuck. Instead, the plastic drain valve blew out, and their house was flooded when the main line thawed. Moral: Just as with anode replacement, the importance of T&P valve inspection is not stressed, and ignoring either can lead to trouble."

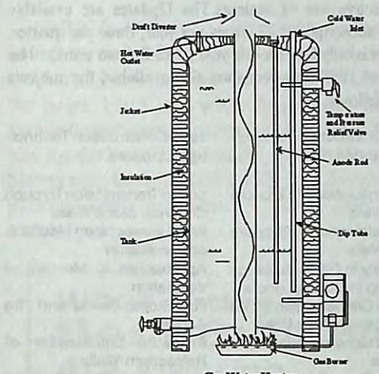
I have heard of a similar situation where the inlet line to the water heater was blocked, the T& P valve was corroded shut, the thermostat failed in the closed position and the water heater top exploded and drove the top of the water heater through the roof of the house. There is a tremendous amount of potential energy stored in a water heater!

Most people are afraid to test their T& P valve, as they are concerned that the valve will leak after the test. Here is how the authors deal with this problem:

"The way to test the valve is to flip the steel lever on the top of the valve so it lifts the brass stem it is fastened to. Check to make sure it allows plenty of water out. (Use a pail under the outlet pipe from the T& P valve.) If it fails to open or if, after use, it leaks, try operating the lever several times. If that doesn't stop the leak, try tapping the stem lightly. If it continues to leak, it will need to be replaced."

The book is filled with many similar gems of information. As one reviewer noted: "The book's tone, like its binding, is unpretentious and pragmatic, and every page is graced with a bit of wisdom . . . try Thomas Carlyle on water heaters: "The foul sluggard's comfort: 'It will last my time.'" ☼

***The Water Heater Workbook** by Larry and Suzanne Weingarten published by Elemental Enterprises, P. O. Box 928, Monterey, California 93942.*



Gas Water Heater

How Good are Filters?

Many new, "improved" forced air system filters are available today. Is it really worth buying one of these good filters? Each manufacturer claims their product is much more efficient than the standard throwaway fibreglass filter. But are they really?

We know that filters can be from less than 5% to more than 99% efficient. Several studies show that there are limits to the maximum particulate reduction possible. Yet the intent of filtration is to reduce the number of particles in the environment that can be inhaled. A key point is that filter standards often use only weight of particulate trapped, which will not really affect respirable particles.

It helps to remember that particulate matter is all around us. It comes from the outside, and also generated inside. It includes smoke from tobacco, candles, and other combustion sources, cooking bi-products (e.g., burnt toast), dust tracked-in from outside, human and animal shedding (hair, skin, etc.), material bits (rugs, clothes, etc.), biological sources (dust mite pieces, mould spores, bacteria, etc.), and many miscellaneous bits such as renovation dust, talcum powder, eraser crumbs, etc.

Standard tests rely on a sampling at a single point in the middle of a room. However, we can think of people as having a little dust cloud around them, continuously generating particulate, so that a single point test is not going to give a good picture of what is really going on in the room as far as distribution of particles.

A study being done by Dara Bowser for CMHC is looking at filter performance. The tests are short term and the findings only provide an indication of filter performance reflecting standard practice for filter installations. However, they point out where more research is needed and what can be expected from filter performance.

The results are still being analysed. Preliminary findings are giving some interesting results. It seems that the peak dust levels are not significantly affected by the type of filter. However, good filters speed up the decay in dust levels. Is there a better type of filter? It seems that electronic filters perform best, followed closely by the mid efficiency pleated filters. Bypass filters may perform better in long term tests with optimized fan flow rates. ☼

The findings of this study are preliminary, and were presented at the Ontario Builder Forum in January 1999. A report is due to be published later this year.

NRC·CNRC

IRC Construction Technology Updates

The National Research Council's Institute for Research in Construction (IRC) offers an excellent publication series for construction professionals. Launched in 1997, The Construction Technology Updates is an IRC series that continues in the tradition of the popular Canadian Building Digests (which were produced from 1960 to 1990). The Updates deal with many key technical issues the construction industry faces today.

Written by IRC researchers, the Updates provide results and practical applications of research work, and also tackle some age-old performance problems that continue to plague the industry. The results are backed by solid building science explanations. The Updates refer to building code requirements and standards as appropriate and explain key code changes. Each is a short 4 to 6 pages, and includes drawings, photos and tables supporting the text.

The topics for 1999 include: noise transmission through floors; electrical outlet boxes and effects on noise transmission; seismic upgrading of buildings; thermoplastic polyolefin roofing membranes; cellular plastic insulation; problems with muntin bars in windows; roof performance under dynamic conditions; rainscreen wall design; exterior insulation for house basements; wind-driven rain and its effect on wall design; emissions from building materials; effective use of sealants.The Updates are available only by subscription, 12 issues per year, three per quarter. The cost is only $49 for one year ($89 for two years). The 1997 and 1998 collections are also available; the subjects are as follows:

1997 Construction Technology Updates	1998 Construction Technology Updates
Sound Insulation of Gypsum Board Walls	Sound Transmission Through Concrete Block Walls
Fire Resistance of Gypsum Board Walls	Why Houses Need Mechanical Ventilation
Air Quality in Office Buildings	Approaches to Mechanical Ventilation
Blistering in Built-up Roofs	Fire Stops: Sound and Fire Aspects
Window Condensation in Old Buildings with New Uses	Pressure Equalization of Rainscreen Walls
Fire and Concrete-filled Steel Columns	Measuring Half-cell Potential in Concrete
Metal-tie Corrosion in Masonry	Evaluating Post-tensioned Buildings
Building Durable Concrete Structures	Fire Resistance of Floor Assemblies
Evolution of Wall Design against Rain Penetration	Individual Control over Office Lighting
Office Lighting Investments	Control of Floor Vibration
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Sprinkler Protection of Windows	Surface Preparation of the Concrete Substrate

To order the Updates, call IRC Publication Sales at 1-800-672-7990 or 1-613-993-2463 (local or U.S. calls). A sample Update (No. 16, Sound isolation and fire resistance of assemblies with fire stops) can be found on IRC's web site at: *http://www.nrc.ca/irc/catalogue/ctu.html* (English)

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Fax 604-488-1436

April 29-30, 1999
Macanex '99
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Fax 514-626-4298 or 1-800-263-0297

May 12-14, 1999
Connections '99: Enabling the Networked Home
Canadian Automated Buildings Association
Tel: 1-888-798-2222
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www.caba.org

May 18-20, 1999
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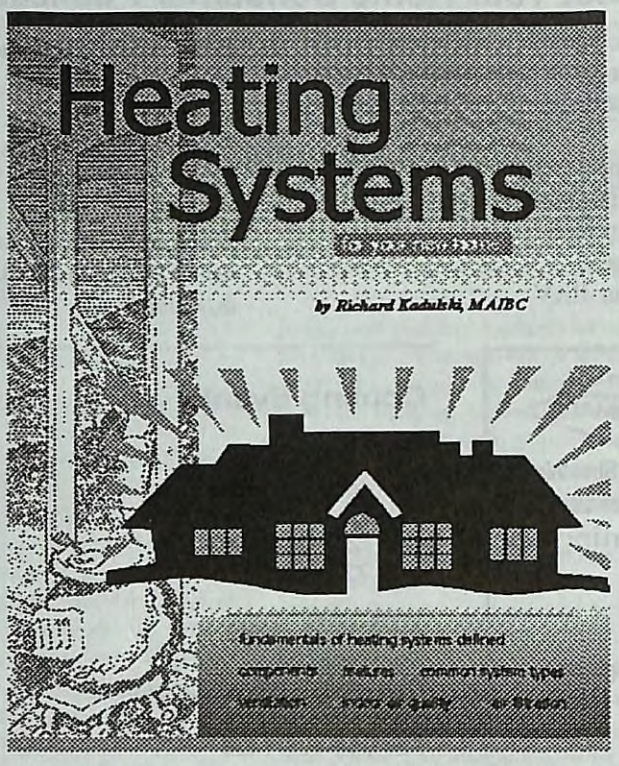

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